Arthropods that attack man and domestic animals in British Columbia (1951 – 2001)

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INTRODUCTION

In 1951, the Dominion Livestock Insect Laboratory, built in 1938 on 32 acres of Mission Flats on the western outskirts of Kamloops, was the centre for Medical and Veterinary Entomology in the Province (Fig. 1). J.D. Gregson was in charge and ran the very successful tick laboratory that did much to reduce the incidence of paralysis of livestock, and the occasional human, caused by bites of the rangeland tick, *Dermacentor andersoni*. L.C. Curtis was in charge of the Household and Medical Entomology Unit until he retired in 1969. He was heavily involved in testing new post-war insecticides and repellents and many of our Society's photographs show him with a portable sprayer or fogger. G.P. Holland, who had been involved with Gregson in the biology and control of fleas, mosquitoes, warble flies and ticks, had just left the laboratory in 1948 to head the Systematics Unit at the Central Experimental Farm, Ottawa. He had been responsible for identifying many thousands of fleas sent in by the Plague (*Yersinia pestis)* Survey carried out during and after World War 2.

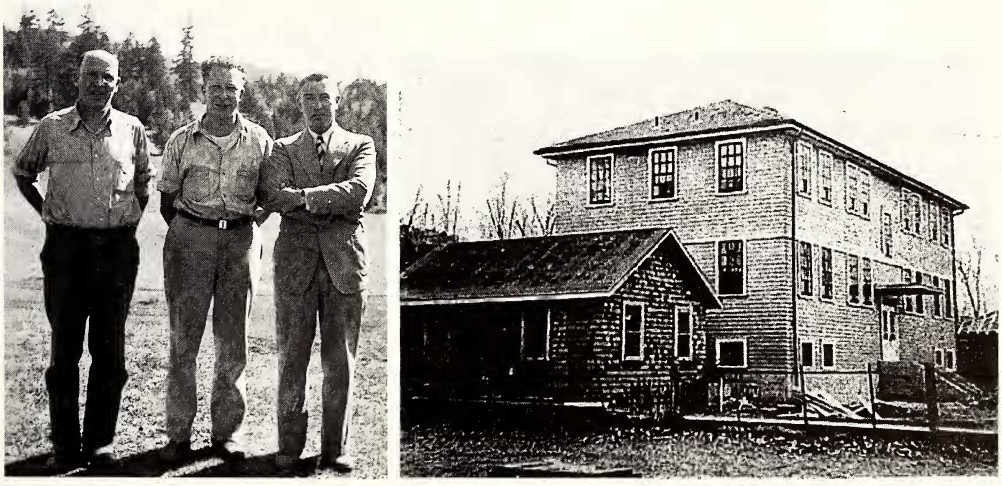

Figure 1. Left, Professor George Spencer, Ivor Ward and G. Allen Mail. Right, newly completed Kamloops Laboratory. In the 1940s, Mail had just taken over from Spencer as Officer-in-charge of the Lab. Ward shared an interest in grasshoppers with Spencer and later became Provincial Entomologist until his untimely death in 1947.

All three left milestone publications of their Federal work (Gregson 1956, Curtis 1967, Holland 1949). Holland was partly replaced by J. Weintraub who acquired a lasting interest in insects as a summer student at the Dominion Parasite Laboratory in Belleville. He was appointed in 1949 and quickly became a world expert on the ecology and physiology of warble flies. G.B. Rich also joined the Livestock Laboratory that year as a student assistant from UBC. He worked with Weintraub on the flight range of warble flies, and with Curtis surveying mosquitoes and controlling them at their breeding sites. He later became well known for his work with lice, and devised some of the early trials of systemic insecticides to control lice and warble grubs. His careful large-scale experiments showed that cattle grubs and lice could be eradicated over as much as 200 square miles of ranchland.

TICKS

Research on our ticks was continued by P.R. Wilkinson who studied their management, resistance, life histories and host relationships until the Livestock Insect Section was closed in 1971. Wilkinson then joined Weintraub who transferred to the larger Federal Research Station at Lethbridge, AB in 1953.

Ticks are potentially the most important vectors of human diseases in the Province. In addition to causing the paralysis that was responsible for at least 27 human deaths by the 1950s (Gregson 1956), they can transmit Powassen and Colorado tick fever viruses, Rocky mountain and Q fever rickettsias as well as the spirochaete bacteria that cause relapsing fever and Lyme disease. Relapsing fever was first reported as an outbreak in the Kootenays in the 1930s (Palmer and Crawford 1933) and bites from the fast-feeding tick *Ornithodoros hermsi* probably were, and continue to be, responsible (Gregson 1956).

Lyme disease, which made a sudden appearance in an epidemic at Old Lyme in the eastern United States in 1977, has a curious history. By 1990, 11 cases had been reported in British Columbia as well as 84 in Ontario and Manitoba (Anon.1991). The western vector, *Ixodes pacificus*, was a severe problem in the 1940s in West Vancouver, the Malahat on Vancouver Island and Harrison Bay and Cultus Lake in the Fraser Valley. At that time, however, it was not associated with disease but was known for its painful slow-healing bites that could be exacerbated if the long mouthparts broke when the tick was being removed. There is still some doubt whether Lyme disease is established in our Province. People travel freely across the continent and modern and extremely sensitive chromosomal diagnostic techniques may exaggerate its prevalence but, on the other hand, before these techniques were used, real cases of Lyme disease may have been misdiagnosed as arthritis from other causes.

Tick research in BC is still largely concerned with livestock and a Ministry of Agriculture entomologist at the Kelowna office, H. Philip, in collaboration with T. Lysik in Lethbridge is currently looking at immune responses to tick bites.

SPIDERS

In the last 50 years two types of spider bites have been reported. Western black widow spiders (*Latrodectes hesperus*) are not uncommon in southern BC. The females are large, about 2cm across the legs, and have a shiny black abdomen, with ventral red markings on most specimens. They can inject a neurotoxic venom with their bites which occasionally require medical treatment, but G.A. Mail, Gregson's predecessor at the Kamloops Laboratory found that the venom had no effect when injected into the leg muscle of a guinea pig. Perhaps encouraged by this, Mail tested it on his own arm, which became red, swollen and painful for about 4 days. When he heard of it, the Dominion Entomologist, Arthur Gibson told Mail firmly to restrict his experiments to the laboratory animals

(Riegert 2000). The symptoms can usually be treated successfully with calcium injections. The other type of spider bite seems to cause slow healing wounds. One of the earliest medical investigations of it in the Province was reported from Kamloops (Davies 1963). The patient was bitten on the thigh, she believed "during the night" and necrotic arachnidism was diagnosed although the spider was not found. Such bites are often attributed to *Loxosceles reclusa*, the brown recluse of the southern US, but R.G. Bennett (2002) has recently emphasised that this species, whose bite can cause serious necrotic injury, has not been recorded in BC (nor in Canada). Since the early 1980s there has been an increasing number of reports of such bites being blamed on the introduced agelenid hobo spider (*Tegenaria agrestis*) which can be found at various localities, and often in homes, in southern BC. In 1999 Dr.G.Willis of the Vancouver Poison Control Centre received 132 calls (but still less than 1% of her annual total) relating to spider bites. Bennett notes that reports of such bites claimed to be from *Tegenaria* species are seldom accompanied by the actual spider and are better explained by other factors. Binford (2001) gives some of these explanations and shows convincingly that the proteins in the venom of these introduced spiders are not significantly different from those found in Europe where necrotic bites from them have never been reported. A search for necrotizing enzymes like the sphingomyelinase D found in recluse spiders (Goddard 1999) might be worthwhile.

BITING MIDGES

A group of biting flies that were just considered a nuisance, the Ceratopogonidae (biting midges or no-see-ums), became important in 1975 when Bluetongue, a quarantinable virus disease of sheep and cattle, was reported for the first time in Canada near Osoyoos. Seven species including one thought to be a major vector, *Culicoides variipennis*, were known in the Province (Curtis 1941) but none had been collected in the south Okanagan valley. Agriculture Canada organized an extensive survey led by R.D. McMullen. They identified another 9 species of mammal-biting midges but no virus was detected in the many adults of *C. occidentalis* and other potential vector species tested (McMullen 1978). It is now certain that *C. sonorensis* is the major vector of Bluetongue virus and that it was previously misidentified in BC as both *C. variipennis* and *C. occidentalis* (Holbrook *et al.* 2000). A second surge of interest in these insects followed the recognition of their association with Sweet Itch, an allergic reaction of horses to midge bites. Fifteen cases, the first in Canada, were reported in southwestern BC (Kleider & Lees 1984) and a later survey by Anderson *et al.* (1988) showed that up to 26% of horses in the Province were affected becoming unrideable and unworkable. She trapped two new midge species bringing the total in BC to 18 (Anderson *et al.* 1993). Borkent (unpublished 2001) has now identified 31 species of these pests from the Province and suggests that another 11, found just across State and Provincial borders, may also be here.

BLACK FLIES

The start of our second half century was marked by an outbreak of another group of biting flies, the Simuliidae or black flies, in Cherryville in the Shuswap region (Curtis 1954). In 1952 the Provincial Entomologist, C.L. Nielson, was asked to investigate their control. He enlisted the help of L.C. Curtis who found many black fly larvae in Cherry Creek in March and used a control program based on the one perfected by F.J.H. Fredeen in Saskatoon (Riegert 1999). Treatment with 0.1ppm DDT cleared Cherry Creek, Eight-Mile Creek and the Shuswap River of black flies much to the satisfaction of local ranchers. The fly, at first thought to be a new species, was later identified by Fredeen as *Simulium defoliarti*, a large-mammal biting species less toxic to cattle than the prairie biter, *S. arcticum*. Nevertheless it seems to have caused some cattle deaths although our Province

appears to be less affected than Alberta and Saskatchewan where *S. arcticum* can still cause toxic and allergic reactions and fatal stampeding.

MOSQUITOES

Mosquitoes are second only to ticks as carriers of human diseases. Two viruses, Western equine encephalomyelitis (WEE) and Snowshoe Hare (SSH), in the California group, have or can potentially cause clinical disease in BC. Two human deaths from WEE occurred in the Interior in 1971 and cases are reported in unvaccinated horses, presumably brought north by virus-infected migratory birds. SSH is endemic in the north but does not seem to cause disease in humans west of Ontario (McLean 1975). Some viruses with very high concentrations in the host's blood can be transmitted on the mouthparts of almost any biting insect. Fortunately mosquitoes have never been found to transmit Human Immunodeficiency Virus in this way but the fatal Myxoma rabbit virus is thought to be transmitted thus by mosquitoes in the western US and is a potential threat here. Human malaria has not been transmitted so far in BC by our indigenous *Anopheles* species although one of them, *An. freeborni* is a capable vector in the southwestern US. Mosquitoes can also transmit parasitic nematodes but the only one of concern in the Province is a heartworm restricted to dogs and the odd cat, perhaps only established in the dry interior (Slocombe 1999).

Curtis (1967) described 42 mosquito species in BC and listed five more that might be expected. Since then, two species new to Canada, *Aedes togoi* and *Ae. nevadensis*, and two of the species Curtis expected, *Ae. melanimon* and *Culiseta minnesotae*, have been found in the Province bringing the total to 46 (Belton 1983). *Aedes togoi*, first collected in Horseshoe Bay, is thought to have arrived by boat from Japan and is now known from rock pools in Cortes Island south to Fidalgo Island, WA, in the south and west to Bamfield on the Pacific coast, all of them close to harbours. In Asia, *Aedes togoi* is a known vector of both Japanese B Encephalitis and filarial nematodes.

OTHER BITING PESTS

In 1955 the Provincial Entomologist, C.L. Neilson, with the help of the Federal entomologists in Kamloops, kept agricultural workers up to date on the recommended control practices for other biting livestock insects with a duplicated "Handbook of the Main Economic Insects of British Columbia". He mentions female horse and deer flies that can consume their own weight in blood at each feeding and transmit tularemia in the Interior of the Province. He knew of 24 species in BC, all of which bite, most of them between June and September. Teskey (1990), who recently updated this number to 60 species, names another seven diseases of mammals that they can transmit in North America and pointed out that their painful bites make them likely to be dislodged while feeding and thus more likely to transmit infections to their next host. Snipe flies (Rhagionidae) like the horse flies to which they are related, can sometimes be troublesome human pests in woodland, even in greater Vancouver. Neilson also deals with horn flies, stable flies, keds, biting and sucking lice and poultry mites in his handbook and all of them can be found as biting pests of domestic animals today.

MANAGEMENT

In the 1950s and 60s DDT and methoxychlor were thought to have a relatively low toxicity but Neilson (1955) warned agricultural workers that DDT was eliminated very slowly by mammals and would "build up if not used wisely." Some of his recommendations were for rotenone, derris and pyrethrum – "almost non-toxic for man

and animals." Some of the techniques he suggested were designed to limit the broadcast use of pesticides, for example setting up self-applied back-rubbers in pastures and paddocks to control lice and flies.

Curtis (1967) recognised that the removal of larval habitat was "the most important and efficient" method of mosquito abatement and this has been going on, consciously or not, since the first immigrant settled in the Province. He promoted larviciding with pesticides or by encouraging predators and parasites as the next best management technique "as the larvae are confined to their native water and cannot escape". He described adulticiding as "the method of last resort" to be used when larval treatment was not possible or when adults invaded from distant breeding areas. This advice can hardly be bettered although there is valid concern nowadays for the preservation of wetlands. Curtis wrote that at that time "the most spectacular, popular and expensive method" of controlling adults was by aerial spraying, covering large areas in a short time. Using persistent insecticides this technique provided immediate relief and often also a barrier to further invasion. Unfortunately in the mid-1960s there were several incidents where pesticides were misused. In Kamloops, for example, 45 gallon drums of DDT and 2-4-D were confused and an airspray defoliated most of the urban trees leaving a large population of adult mosquitoes unharmed. Adding insult to injury, many of the trees, which probably would have recovered, were cut down and replaced. Several such incidents lead to the drafting of new regulations for the old Pharmacy Act in 1969. Courses were taught and examinations required for licenses to resell and to use pesticides and for certification of individuals to dispense and apply them.

At that time a strong environmental lobby group, pioneered by SPEC, the Society for Pollution and Environmental Control, developed in the Province and there was considerable opposition to aerial adulticiding particularly in Coquitlam. Malathion, a short-lived organophosphate and Baygon, a longer lasting carbamate insecticide were registered for aerial application but in 1971 some of the residents showed their objection to this procedure by flying balloons in the path of the spray plane.

The New Democratic Party came into power in 1972 and ordered a Royal Commission on Pesticides and Herbicides. The commission recommended (14-III) "Aerial spray for mosquito (sic) should only be permitted if there is a real threat to human health or livestock. The decision to allow aerial spraying for adult mosquitoes should lie solely with the Minister of Health Services and Hospital Insurance. Aerial distribution of chemical larvacides should only be undertaken under permit from the proposed Pesticide Control Branch." It also recommended that Provincial Government leadership should be provided "to establish rational ongoing mosquito control programmes." At that time the Ministry of Agriculture employed a medical entomologist, R.A. Costello, but until 1974 he was in a Ph.D. programme at Simon Fraser University and unable to devote much time to mosquito control. However in 1976 the Minister of Agriculture, Don Phillips, approached P. Belton, an impartial academic with an interest in mosquitoes, to chair a Provincial Mosquito Advisory Committee. The committee included Costello, two medical doctors, a pesticide chemist, representatives from Environment Canada, Provincial Fish and Wildlife, a private consultant and (a masterstroke) Mrs. M. Doucette, the chair of SPEC. For just over 10 years, and with a few changes in membership, the Committee amicably prepared and revised a Mosquito Control Guide and generally advised the Minister of Agriculture on policies and procedures. In 1978 the new Provincial Pesticide Control Act came into force and by 1987 the Ministry of Environment had taken over the regulation of pesticides, following the recommendations of the Royal Commission, and the Ministry of Agriculture and Food no longer published the Guide. For several seasons mosquitoes had not been a great problem, partly because of low river levels associated with slow melting snow. Another reason was the improved management of the larvae of human-biting species, with

better mapping of breeding sites and the intelligent use of the very effective and selective *Bacillus thuringiensis*, serotype H14 larvicide. In 1988 the Mosquito Advisory Committee quietly dissolved.

In the 21st century, most active control of biting flies is done by larviciding. Highly effective and specific bacterial toxins are applied to breeding sites, which can be mapped and located using satellite techniques. Door and window screens and repellents are often recommended as a first line of defence, but in most regions adults may be controlled on request, often requiring unanimous groups of local residents. One of the original controversial organophosphates, malathion, is still being used applied from the ground to control adult mosquitoes when their numbers warrant it. Unless there is a medical emergency, the malathion is applied as a low volume spray from trucks which can avoid residents who object to spraying and others likely to be affected, such as beekeepers.

CONCLUSIONS

Biting insects and arachnids in BC seem to have survived about 10 millennia of competition with humans. Our development of their habitat has undoubtedly reduced the numbers of some species, but others, for example, that can develop in ditches, irrigation runoff and containers, may have benefited. Dams may reduce seasonal flooding of rivers but often change their characteristics to the advantage of some species of black flies (Riegert 1999). Many species of ticks feed on several different hosts during their life cycle, and changes, for example in the population of lizards, mice or deer, might affect the numbers of ticks that could feed on humans. There is also valid concern that global warming, possibly related to the increase in human population might increase the population of disease-bearing species in what are now cooler parts of the planet. It might also prolong the life of some vectors, giving them more opportunity to transmit diseases.

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